

### **In the Specification**

***On page 1, please replace the first two paragraphs with the following:***

#### **TECHNICAL FIELD**

This invention relates to a method of producing coke for metallurgy, and more particularly ~~proposes~~ a method of producing high-strength coke for metallurgy capable of using in a large size blast furnace by blending a great amount of brand coal near to the quality of a coal blend for the charge in a coke oven to form the coal blend consisting of only a few brands of coals without blending many brands of coals.

#### **BACKGROUND ART**

~~In case of~~ When making molten iron in a blast furnace, it is first necessary that iron ores and coke are alternately charged into the blast furnace and filled therein in the form of layers; ~~and these.~~ The iron ore and coke are heated by hot air of high temperature blown through a tuyere and at the same time the ore is reduced to iron by CO gas generated through combustion of coke.

***Please replace the paragraph spanning pages 1 and 2 with the following:***

In the production of such coke for the blast furnace, it is required to carbonize the coal blend (charging coal) for charging into a coke oven having a constant coking property and coalification degree. For this purpose, a raw coal having a good quality (which is mainly called by a production area, and is called as a brand) is necessary. Recently, such brands of coals (hereinafter referred to as a “raw coal” ~~simply~~) is difficult to ~~be get~~ obtain in a great amount. Therefore, there has been used a so-called ~~the~~ “coal blend” obtained by blending many kinds of the raw coals having different properties in accordance with the production country and production area (usually 10~20 brand coals).

***On page 2, please replace the first and second full paragraphs with the following:***

In such ~~the~~ a coal blend, it is common to blend coal of one brand in an amount of not more than 20 wt% at most. This blending thought lies in that the raw coals are blended so that a quality of coke obtained by carbonization of the coal blend in a coke oven is made to be not less than a certain level. For example, it is enough to balancedly blend fibrous components forming a skeleton of coke (which is evaluated by the coalification degree of coal using volatile component, C wt%, vitrinite reflectance and the like as an indication) with coking component forming an aggregate through coking of coal particles (there are fluidity of coal, expansion degree, tackiness index and the like as an indication). That is, the strength of coke after carbonization is ~~guessed~~ obtained by calculating the quality as the coal blend based on coalification degree and coking property of each brand of raw coals.

At the present, 10~20 brands of raw coal[[s]] are usually blended as a coal (coal blend) charged into the coke oven used for the production of coke for a blast furnace. According to this method, the influence of the properties of the raw coal per one brand upon the qualify of the coke as a final product becomes small. Therefore, even in the case of coal unsuitable for the production of coke for blast furnaces, it may be blended only in a small amount, and serves to stabilize the quality of coke as a merit.

***On page 3, please replace the first through fourth full paragraphs with the following:***

Among the raw coals being cheap and available in a greater amount, for instance, there is medium coking coal having a high content of inert component indicating a[[n]] mean reflectance of 0.9~1.1 and a maximum fluidity of not more than 3.0. And also, such raw coals ~~indicate~~ have substantially the same quality property as in the above usual coal blend. According to the inventors' study, however, when a greater amount of this raw coal is blended and carbonized, the

desired coke strength can not actually be obtained though the quality is similar to that of the coal blend, and hence it is ~~obstructed~~ difficult to use it in a greater amount.

On the other hand, according to the conventional method of blending many kinds of raw coals having a certain quality, e.g. about 20 brands of coals must be always stocked in a coal yard, ~~so that there are~~. This causes problems that in the yard site is ensured and such as the cost for ~~unpacking~~ unloading and quarrying becomes expensive and the like.

In the conventional technique, it is required to adjust and blend many brands of raw coals as a coal blend to be charged into the coke oven as mentioned above. However, the raw coal to be blended is difficult to get in accordance with the brand thereof, or even if such raw coals are ~~get~~ obtained, there is a problem in the maintenance of the raw coals in the stock yard.

Under the above circumstances, it is, therefore, an object of the invention to ~~propose~~ provide a method of advantageously producing coke for metallurgy having an excellent quality such as strength and the like as compared with the conventional method, particularly high-strength coke capable of ~~using~~ use in a large-size blast furnace by blending a greater amount of a brand of a raw coal being cheap and easily available with several brands of raw coals.

***On page 4, please replace the first paragraph with the following:***

#### DISCLOSURE OF INVENTION

The inventors have made various studies with respect to the kinds of raw coals and the blending thereof in order to achieve the above object and found that there is a combination suitability or affinity in a combination of so-called particular brands of raw coals because the coke strength is largely shifted from that estimated from a weighted mean value of each raw coal in accordance with the method of combining raw coals of different production countries (each brand coal). That is, it has been confirmed that the strength required as a coke for metallurgy is

obtained by utilizing the affinity of particular brands of raw coals with the other brand of raw coals even if the raw coal is restricted to a few brands and these brands are blended, and as a result the invention has been accomplished.

***On page 5, please replace the fifth and sixth full paragraphs with the following:***

Fig. 2 is a graph showing ~~an~~ the influence of the blending ratio of middle coalification and low fluidity coal and a hard coking coal upon coke strength (tumbler strength).

Fig. 3 is a graph showing ~~[[a]]~~ the relation between the blending ratio of middle coalification and low fluidity coal and coke strength.

***Please replace the paragraph spanning pages 5 and 6 with the following:***

Fig. 4 is a graph showing ~~[[a]]~~ the relation between the blending ratio of middle coalification and low fluidity coal and coke strength when blending two middle coalification and low fluidity coals having similar properties.

***On page 6, please replace the first through third full paragraphs with the following:***

#### BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the invention will be described in detail, ~~with the course developing the invention below.~~

Fig. 1 is a graph showing indicating qualities of main brands of raw coals (64 brands) imported in Japan at the present time, wherein ~~an~~ the abscissa is a coalification degree  $R_0$  of coal (as  $R_0$  becomes higher, the coke strength in the carbonization increases) and ~~an~~ the ordinate is a fluidity MF of coal (indication of coking property of coal).

As the present time, as a coal blend charged into a ~~a~~ [[n]] coke oven, 10~20 brands of raw coals among raw coals imported in Japan are blended so as to adjust the properties to coalification degree  $R_0 = 0.9 \sim 1.2$  and fluidity MF = about 2.3~3.0.

***Please replace the paragraph spanning pages 6 and 7 with the following:***

For instance, the inventors have ~~particularly noticed~~ examined the particular brands of raw coals and found that medium coking coal having a middle coalification degree and a low fluidity (hereinafter referred to as middle coalification-low fluidity coal) tested is shown by a black circle in Fig. 1 and is approximately equal to a grade of coal blend having a coalification degree  $R_0 = 1.05$  and a fluidity  $MF = 2.4$  (charging coal). This means that it is possible to blend a greater amount, for example, not less than 50% of such a middle coalification-low fluidity coal. According to the inventors' studies, however, it has been confirmed that when the middle coalification and low fluidity coal is merely blended in a greater amount, the coke strength considerably lowers and is unsuitable as the coke for metallurgy. As a result of searches, there are considered various causes that the equilibrium moisture content in the total water content of 7.5% is as high as not less than 3.5% (usual raw coal is about 2.5%) and the like. Among them, it has been confirmed that a maximum cause lies in a point that the inert component such as fusinite, semi-fusinite or the like as a coal structure component is 10~less than 30% in the usual raw coal and as high as 40~50 wt% in the middle coalification and low fluidity coal.

***On page 7, please replace the first full paragraph with the following:***

~~For~~ To this end, the inventors ~~expect~~ investigated the “affinity” as a blending property of the coals and examined on the combining affinity of the middle coalification and low fluidity coal with the other brands of reinforcing coking coals, particularly hard coking coal and medium coking coal. That is, various coal blends are prepared by blending the middle coalification and low fluidity coal with several kinds of strength-reinforcing coking coals shown in Table 1 and the coal blends are subjected to carbonization test in a ~~a~~ [[n]] coke oven.

***On page 7, please replace the third full paragraph with the following:***

Fig. 2 is a graph showing ~~an~~ the effect of improving the tumbler strength  $TI_6$  when the strength of the coke made from only the middle coalification and low fluidity coal is zero, which shows a comparison the strength of coke made from only the middle coalification and low fluidity coal and the tumbler strength of two coal blend obtained by blending the middle coalification and low fluidity coal and the other brand of strength-reinforcing coking coal. The numerical value in the figure shows ~~[[a]]~~ the blending ratio of the middle coalification and low fluidity coal and the other brand coal.

***Please replace the paragraph spanning pages 7 and 8 with the following:***

Moreover, the tumbler strength as a strength of coke is indicated by a value as measured ~~on~~ in an amount of not less than 6 mm after a sample is rotated at 400 revolutions using a tumbler strength testing machine described in JIS K2151 and then screened.

***On page 8, please replace the first full paragraph with the following:***

As mentioned above, it has been confirmed that when the middle coalification and low fluidity coal (X-coal) is blended with 5~40 wt% of the reinforcing coking coal (A~F) being the other brand raw coal shown in Table 1, even if the coal is blended in a greater amount, the coke strength ( $TI_6 > 83$ ) can sufficiently be ensured and the coke strength of a target as a measure (step maintenance value) usable in a large size blast furnace of 3000~5000 ~~m<sup>3</sup>~~ m<sup>3</sup> class is obtained. In this case, when the blending amount of the other reinforcing hard coking coal (A~F) is less than 5 wt%, the strength is lacking, while when the blending amount of the other reinforcing hard coking coal (A~F) is more than 40 wt%, the blending effect is saturated and the economical merit is lost.

***On page 9, please replace the fourth full paragraph with the following:***

As mentioned above, according to the invention, ~~it is said that~~ it is favorable to blend the middle coalification and low fluidity coal with hard coking coal or medium coking coal having high coalification degree and/or middle coalification degree as a raw coal for the reinforcement of the coke strength.

***Please replace the paragraph spanning pages 9 and 10 with the following:***

As the middle coalification and low fluidity coal, the production country and production area are not particularly restricted, and use may be made of ones similar to coal having large inert component and equilibrium moisture content and the aforementioned properties. That is, as shown in Table 2, Y-coal as a raw coal similar to the properties of the middle-coalification and low fluidity coal is a coal having similar properties except that volatile matter (VM) and maximum fluidity (MF) are slightly high and the mean reflectance ( $R_0$ ) is slightly low. Such raw coals are coals being difficult to use in the conventional blending method likewise the aforementioned middle coalification and low fluidity coal. However, Y-coal can be applied to the blending of few brands of raw coals likewise the above middle coalification and low fluidity coal.

***On page 10, please replace the first full paragraph with the following:***

Moreover, the raw coals having similar properties (Y-coal etc.) may be used together because the mean reflectance ( $R_0$ ) is within a range of 0.9~1.1 and the maximum fluidity (MF) is not more than 3.0 likewise the middle coalification and low fluidity coal.

***Please replace the paragraph spanning pages 10 and 11 with the following:***

Example 1

As X-coal is used as the middle coalification and low fluidity coal as a main raw material ~~is used X-coal as~~ shown in Table 3, ~~and~~. A-coal is used as an example of high coalification coking coal used for the reinforcement of the strength, ~~and~~. C-coal is used as a medium coking coal or hard coking coal indicating a<sub>[[n]]</sub> mean reflectance higher than that of middle coalification and low fluidity medium coking coal. A coal blend for ~~charge~~ charging into a coke oven is prepared by blending them at a ratio of X-coal: A-coal : C-coal = 8:9:10. The properties of each of these coals are shown in Table 3.

***On page 11, please replace the first full paragraph with the following:***

And also, Fig. 3 shows ~~an~~ the influence of the blending ratio of the middle coalification and low fluidity coal upon the strength. As shown in the figure, when the blending ratio of coal blend blending the middle coalification and low fluidity coal is increased, the strength (TI<sub>6</sub>) gradually lowers as shown by “a” as compared with the coke strength of usual coal blend (TI<sub>6</sub> = 84.4%), but the strength is obtained at a level approximately equal to that of the usual coal blend in case of the above blending ratio (X-coal:C-coal:A-coal = 81:10:9) as shown by “b.”

***Please replace the paragraph spanning pages 11 and 12 with the following:***

A coal blend is prepared by using X-coal of Table 2 and Y-coal of Table 2 having properties similar to those of X-coal as plural middle coalification and low fluidity coals being main raw materials, A-coal in Table 3 as an example of high coalification coking coal used for reinforcing strength, and C-coal in Table 3 as an example of ~~meidum~~ medium coking coal or hard coking coal indicating a<sub>[[n]]</sub> mean reflectance larger than that of middle coalification and

low fluidity medium coking coal, and blending them at a ratio of X-coal:Y-coal:A-coal:C-coal = 81-y:y:9:10 (Y = 0~81).

*On page 13, please replace the first paragraph with the following:*

#### INDUSTRIAL APPLICABILITY

As mentioned above, according to the invention, it is possible to produce coke for large size blast furnaces by adopting coal of middle coalification degree and low fluidity having a large inert component, which could not be used in the conventional method of blending a few of each of many brands of raw coals in the conventional coke production for blast furnaces, and blending great amounts of few brands of raw coal[[s]]. As a result, there can be produced coke for metallurgy ~~in a cheap~~ at low cost.